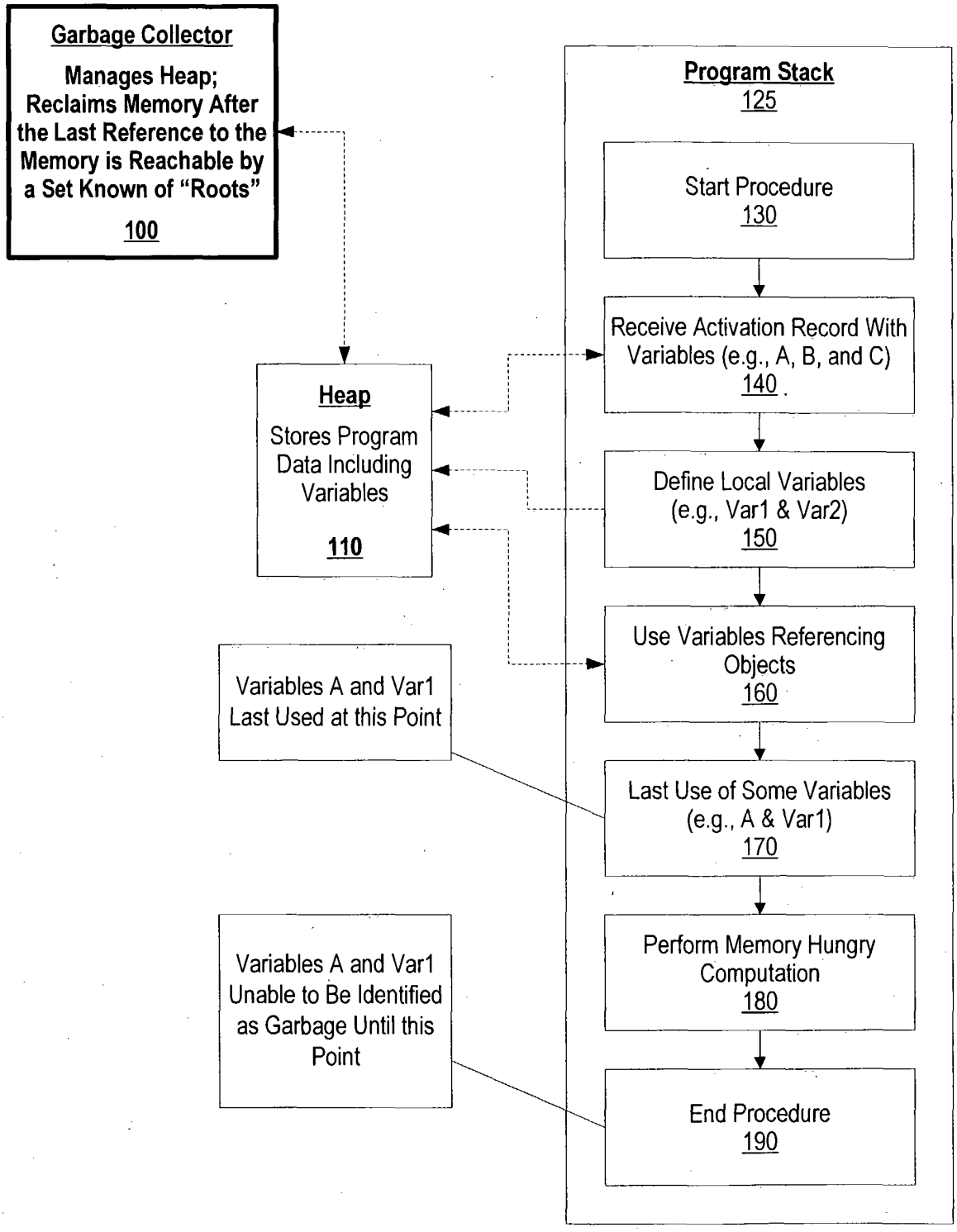

Figure 1
(prior art)

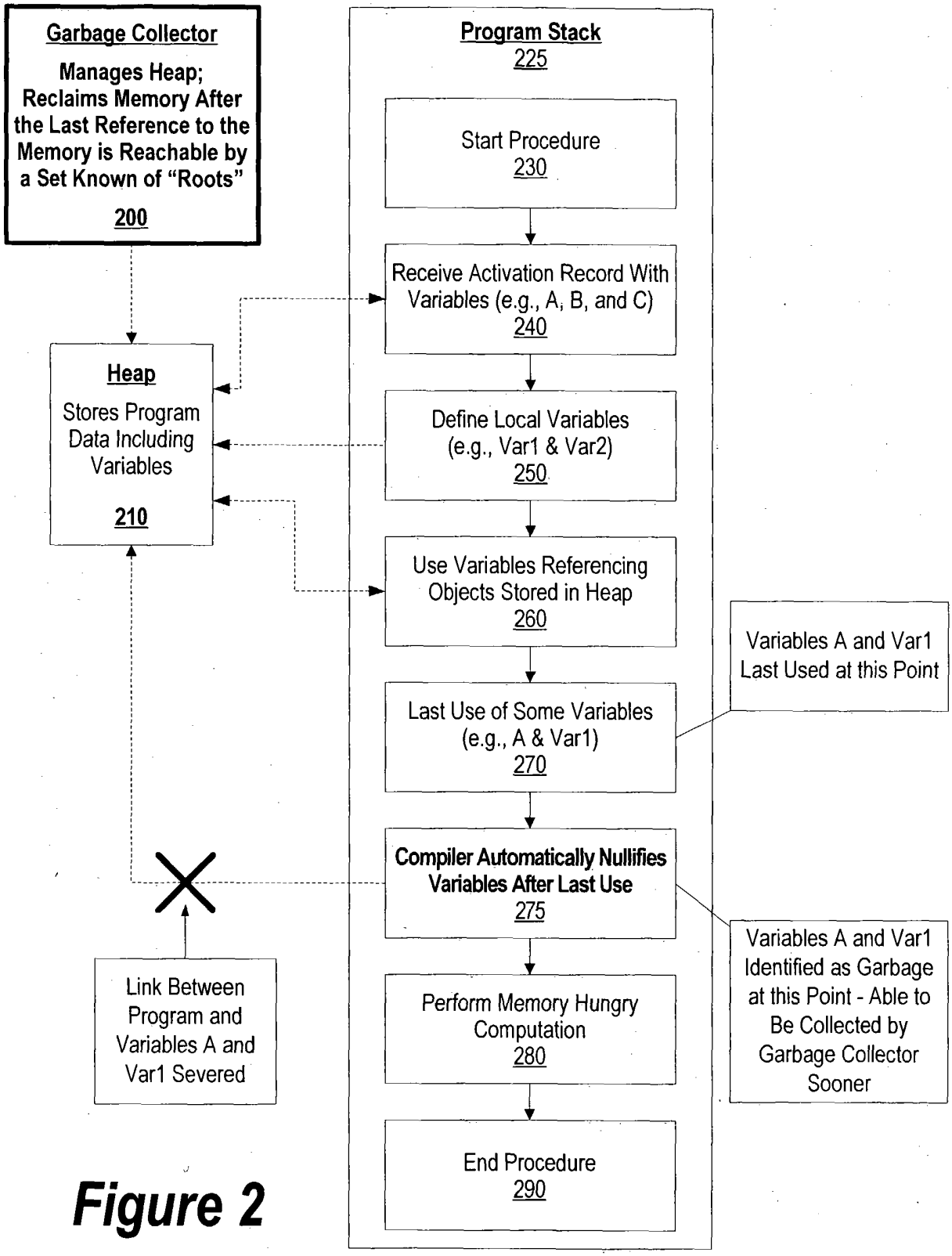
Garbage Collector
Manages Heap; Reclaims Memory After the Last Reference to the Memory is Reachable by a Set Known of "Roots"
200
Heap
Stores Program Data Including Variables
210
Program Stack
225
Start Procedure
230
Receive Activation Record With Variables (e.g., A, B, and C)
240
Define Local Variables (e.g., Var1 & Var2)
250
Use Variables Referencing Objects Stored in Heap
260
Last Use of Some Variables (e.g., A & Var1)
270
Compiler Automatically Nullifies Variables After Last Use
275
Perform Memory Hungry Computation
280
End Procedure
290
Variables A and Var1 Last Used at this Point
Variables A and Var1 Identified as Garbage at this Point - Able to Be Collected by Garbage Collector Sooner
Link Between Program and Variables A and Var1 Severed

Figure 2

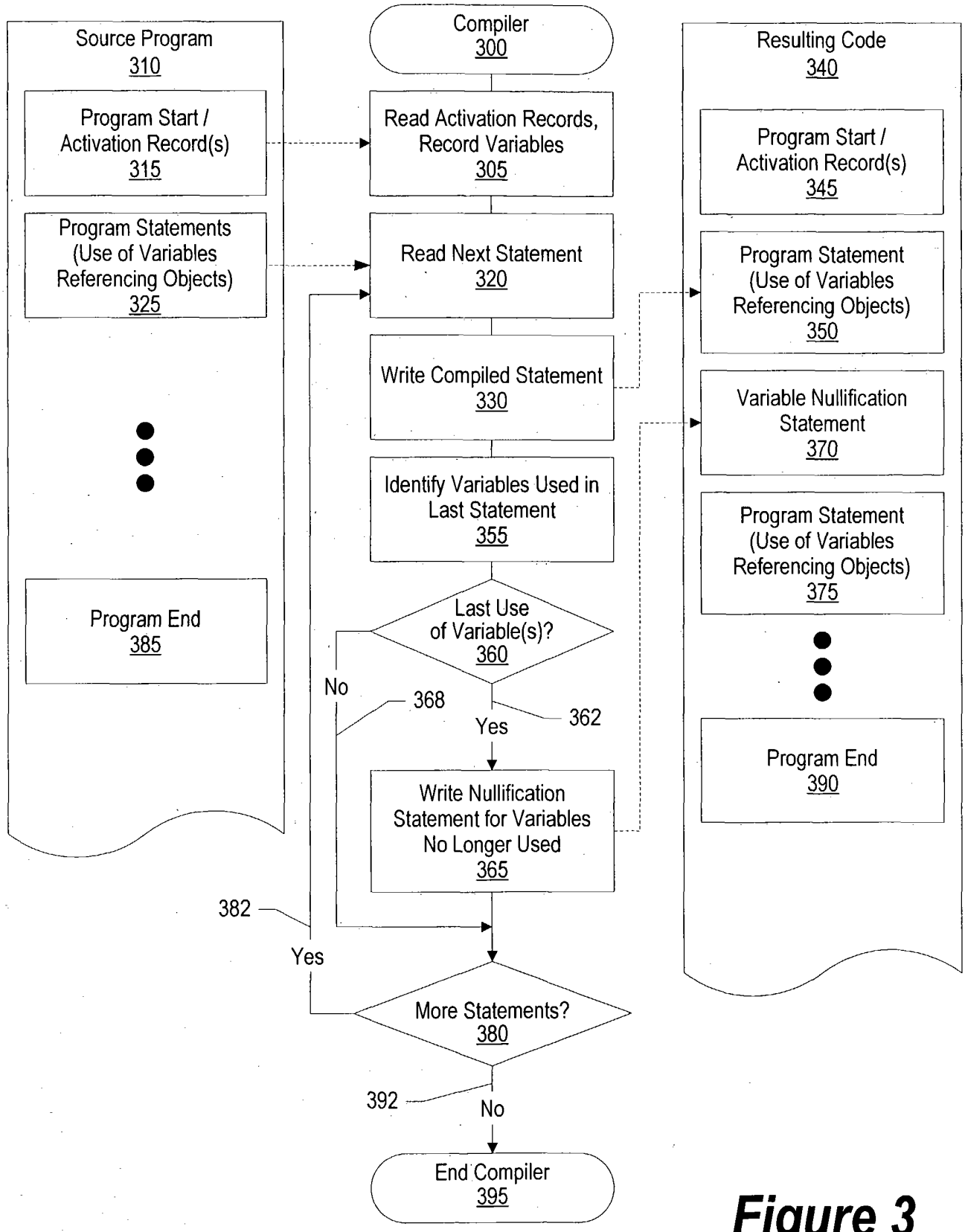
Source Program
310
Program Start / Activation Record(s)
315
Program Statements (Use of Variables Referencing Objects)
325
Program End
385
Compiler
300
Read Activation Records, Record Variables
305
Read Next Statement
320
Write Compiled Statement
330
Identify Variables Used in Last Statement
355
Last Use of Variable(s)?
360
No
368
Yes
362
Write Nullification Statement for Variables No Longer Used
365
382
Yes
More Statements?
380
392
No
End Compiler
395
Resulting Code
340
Program Start / Activation Record(s)
345
Program Statement (Use of Variables Referencing Objects)
350
Variable Nullification Statement
370
Program Statement (Use of Variables Referencing Objects)
375
Program End
390

Figure 3

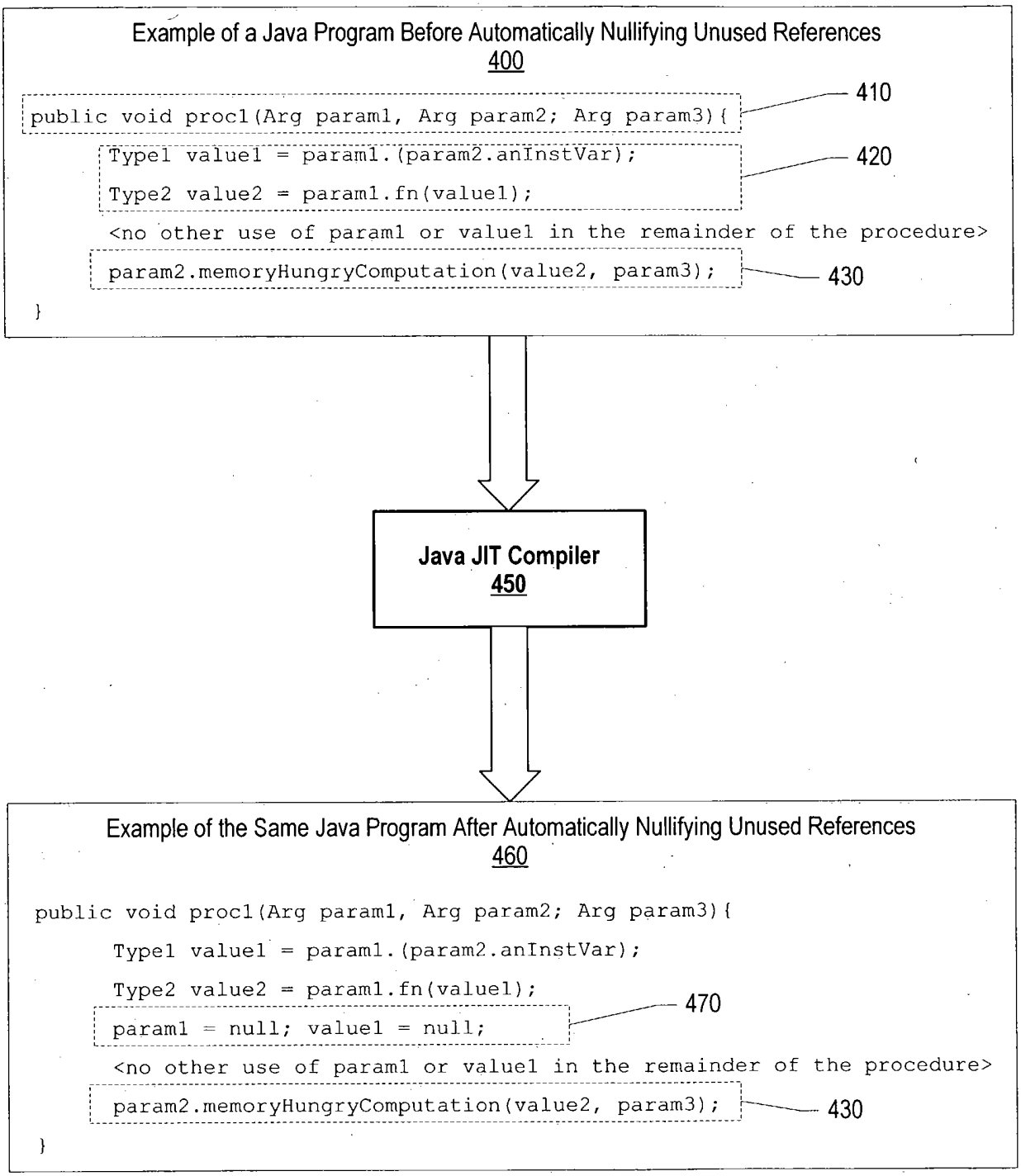
Example of a Java Program Before Automatically Nullifying Unused References
400
public void proc1(Arg param1, Arg param2; Arg param3){
410
Type1 value1 = param1.(param2.anInstVar);
Type2 value2 = param1.fn(value1);
420
<no other use of param1 or value1 in the remainder of the procedure>
param2.memoryHungryComputation(value2, param3);
430
}
Java JIT Compiler
450
Example of the Same Java Program After Automatically Nullifying Unused References
460
public void proc1(Arg param1, Arg param2; Arg param3){
Type1 value1 = param1.(param2.anInstVar);
Type2 value2 = param1.fn(value1);
param1 = null; value1 = null;
470
<no other use of param1 or value1 in the remainder of the procedure>
param2.memoryHungryComputation(value2, param3);
430
}

Figure 4

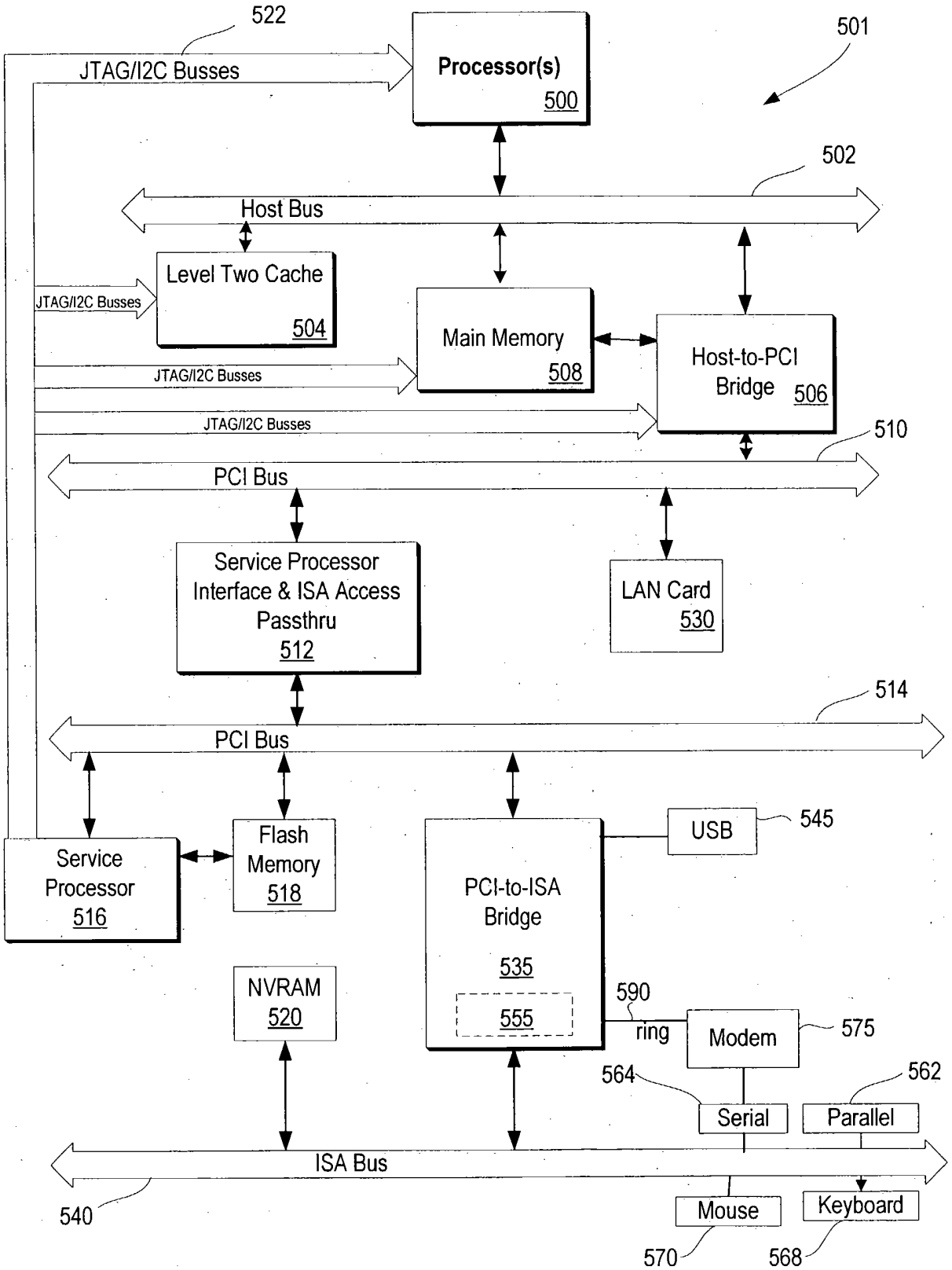
522
JTAG/I2C Busses
Processor(s)
500
501
502
Host Bus
Level Two Cache
504
JTAG/I2C Busses
Main Memory
508
Host-to-PCI
Bridge 506
JTAG/I2C Busses
JTAG/I2C Busses
510
PCI Bus
Service Processor
Interface & ISA Access
Passthru
512
LAN Card
530
514
PCI Bus
Service
Processor
516
Flash
Memory
518
PCI-to-ISA
Bridge
535
555
USB
545
NVRAM
520
590
ring
Modem
575
564
562
Serial
Parallel
ISA Bus
540
Mouse
Keyboard
570
568

Figure 5